The Beauty of Experiment - The Rediscovery of Shadow Tissues

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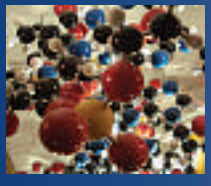
"...scholarships for research and education..."

Newsletter January 2011

The Leverhulme Trust

Arctic climate change 1750 to 1850



Changing codes

Of whales and men

Planetary atmospheres

No malice.... and the consequences

A rough but possible division of research styles is that between the impact-driven and the opportunity-driven. In the first, we tackle recognised objectives such as the elimination of a particular disease or the establishment of a reliable renewable energy source; the target is known, it is widely recognised and progress towards it can be sensibly measured. In the second, we assess the existing knowledge base and we explore the avenues available for its extension; the target is new understanding, it is frequently an individual's quest, and progress lies in the promise for new and meaningful investigation that is revealed. The division is increasingly evident in the current debates relating to university funding and the support of the national research and teaching agendas.

Notwithstanding the soothing softenings applied to the use of 'impact' as a criterion for the guidance of policy, its linking with 'significant social returns' as a mechanism for prioritising the disciplines to be taught in universities does suggest problems for a research agency traditionally loyal to the responsive mode, i.e., where the applicant is required to bear the full onus of responsibility for the selection of research topic. If government policy, as reflected in the funding choices of the public research support system, is to pick winners among the disciplines, then who shall support the rest? Since no private agency can responsibly set its agenda by seeking to fill the gaps created by the quiet departure of the public system, how is the system to retain its optimum shape, i.e., with fair balance between the two styles identified above? The pressures on the retention of a genuinely responsive mode become clear.

It is important to emphasise that this is said without any apportioning of blame. As often in complex systems, the interactions between parties, each of which is acting without malice, can, in total, cause tension or, at least, lead to a less than fully advantageous outcome. The Trust is currently holding firmly to its responsive mode allegiance; but pressures begin to be felt.

Richard Brook

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Ancient numeracy

According to recent findings, one adult in five in England today is innumerate ("We can't allow people to say 'I'm no good at maths'", *Guardian* 27/4/2010). The figure is particularly stunning when compared to adult illiteracy rates, which are closer to 1%. As the article remarks, for a person to admit to illiteracy carries social stigma, whereas many people will not have a problem in proclaiming that they cannot count, do not have a head for figures – that they are 'no good at maths'. Numeracy and literacy, both parts of basic education, are notably asymmetrical in terms of prestige, and of the status attached to possessing, or not possessing, them.

How did things get to be like this? Why is there such a gap between perceptions of numeracy and of literacy – when was it decided that being a poet is more glamorous than being an actuary? I propose to take these questions back to the ancient world, because, for all the differences between past and present, the cultural and pedagogical legacy of the Greeks and Romans may still affect the relative status of numeracy and literacy today.

I will explore three areas:

1) *How* did the ancient Greeks and Romans count, calculate, and measure? How did they carry out the three basic operations, and on what media (fingers, counting boards, papyrus)? What is the significance of using different notations, of writing VIII instead of h instead of 8?
2) What *roles* did numeracy play in Greek and Roman society? How did this role change with the different political character of, say, the Athenian democracy or the Roman Empire? No less importantly, *who* played those roles – clerk, accountant, financial expert, banker, teacher?
3) What were the ancient *attitudes* to numeracy? Did mathematical abilities command cultural prestige – if not, why? How do those ancient views of mathematical education *vis-à-vis* literate education affect what we think today?

A scene from the so-called Darius vase (second half of the fourth century BC, found at Canosa and now in Naples Archaeological Museum). Notice the person calculating and/or recording the tribute brought to the Persian king – as seen through Greek eyes.

Counting, calculating and measuring, were an integral part of the ancient state machine, of simple and complex economies, and of political imagery. Understanding these activities in their many facets will provide new insights not just into the past, but also into more general questions, such as: what is the role of experts – in particular, should they run specific sectors of the state for which expert knowledge is required? What is the relationship between numeracy, money, and accountability – is the idea of a good, honest book-keeper a contradiction in terms? Again, is there such a thing as objective knowledge – for instance, two plus two is four – or is even our consensus to basic arithmetic culturally constructed?

Dr Serafina Cuomo
Birkbeck, University of London

Experimental archaeology meets textile design: the rediscovery of shadow tissues

We know very little about the warp-printed fabrics known as 'shadow tissues' that came to prominence in the 1920s and 30s. Printed warps had been practiced since the mid-nineteenth century in imitation of prior hand-manipulated dyeing techniques. But production remained time-consuming and expensive, limited to luxury dress fabrics such as silks and alpacas. By contrast, shadow tissues used cotton as a basis, and made use of technological advances to simplify and speed up the process. Not only were shadow tissues affordable to a wider public, they were marketed as furnishing fabrics – their reversible nature suiting the new decorating trend for unlined curtains. The fabric was to go out of fashion in the late 1930s when low-quality versions entered the market; and the technique has not been revived since resulting in the loss of knowledge of its practice.

The calico printing firm of Turnbull and Stockdale was a recognised leader in the production of shadow tissues by the early 1930s, when the head of the company contributed an article to *The Cabinet Maker* outlining the development of the technique. Extensive experimentation with the yarns used as the weft component is mentioned, but to protect intellectual property few details are given. Such unwritten methods and technical details can now probably only be obtained by close examination of the surviving cloths.

This project aims to recover technical information about Turnbull and Stockdale's developmental contribution to this printing method, and then to apply this knowledge to creating trial-stage contemporary textiles. The intention is not to learn how to mimic old techniques using new technology, instead, multi-faceted historical and artefactual analysis, creative practice, and entrepreneurial skills will be harnessed together generating new textile products suited to current use. Fabric samples will be printed and woven in sufficient quantity to allow experimentation with further processing, for example erosive and sculpting techniques that are dependant on the yarn types and weave construction.

The practical trials, and commercial applications will be reviewed periodically by Paul Turnbull, managing Director of Turnbull Design Ltd, a print and weave textile company for the high-end furnishing market, and holder of the Turnbull and Stockdale archive.

This research will open up an important private design archive to academic study, examining a very particular by-way in the history of textiles, but with great potential for exploration and exploitation.

Underlying the research is an aspiration to promote British textile design looking to a distinctive national strength by accessing high-calibre design archives. Hitherto, archival design has appropriated historical patterns to produce tame, nostalgic styles. This research aims to plumb archival sources in depth to uncover the design choices and technical adaptations that led to excellence in the past, then to apply these to contemporary production, thus building a bridge to the vitality of past design.

Ms Trish Belford
University of Ulster

Top: preparing the warp; bottom: shadow tissue prior to weave. Images courtesy of the Turnbull and Stockdale archive.

Human rights beyond borders

I work as a scholar and teacher of international law, and at the interface between international law and related academic disciplines, including international relations, world history, post-colonial studies and refugee studies. Within the general field of international studies, my interests lie in the administration of territory by foreign (i.e. non-sovereign) actors, whether international organisations (e.g. the United Nations administering Kosovo between 1999 and 2008) or states (e.g. the US military base in Guantánamo Bay and the US-UK Coalition Provisional Authority occupation of Iraq between 2003 and 2004).

My work on the administration of territory by international organisations, which I named 'International Territorial Administration' (ITA) in an early publication, and the concept of trusteeship over people (e.g. colonial trusteeship and belligerent occupation), includes a monograph published by OUP in 2008 which won the Certificate of Merit (book prize) of the American Society of International Law in 2009. This work was supported by a Research Fellowship from the Leverhulme Trust.

I will be using the Philip Leverhulme Prize funds to support my research on another aspect of foreign territorial administration: the applicability of international human rights standards to it.

The actions of states outside their borders raise a number of important political and legal questions including, fundamentally, whether they are justified, in terms of both the activity itself and the manner in which it is conducted. One aspect of the latter justification concerns whether these actions conform to human rights standards, and this in turn raises its own question as to whether, and to what extent, human rights law applies to extraterritorial state actions, thereby potentially offering one normative framework by which conformity to human rights standards can be judged. However, a striking feature of some of the commentary on certain post-9/11 extraterritorial activities – notably the U.S. detention of several hundred individuals at its Naval Base in Guantánamo Bay, Cuba, in Bagram, Afghanistan, and other secret sites – is the suggestion that these activities take place in a 'legal black hole.'

In my project I will be considering whether and to what extent the norms of international human rights law, such as the European Convention on Human Rights (and in the UK the Human Rights Act), including international refugee law, should be and are applicable to states when they act outside their sovereign territories. This would cover the conduct of warfare and occupation as well as more discrete activities such as the interception of migrants and so-called 'pirates' at sea and the detention, interrogation and transfer of individuals, whether terrorist subjects or migrants (including refugees), abroad.

Dr Ralph Wilde
University College London

Arctic climate change 1750 to 1850: new insights from old documents

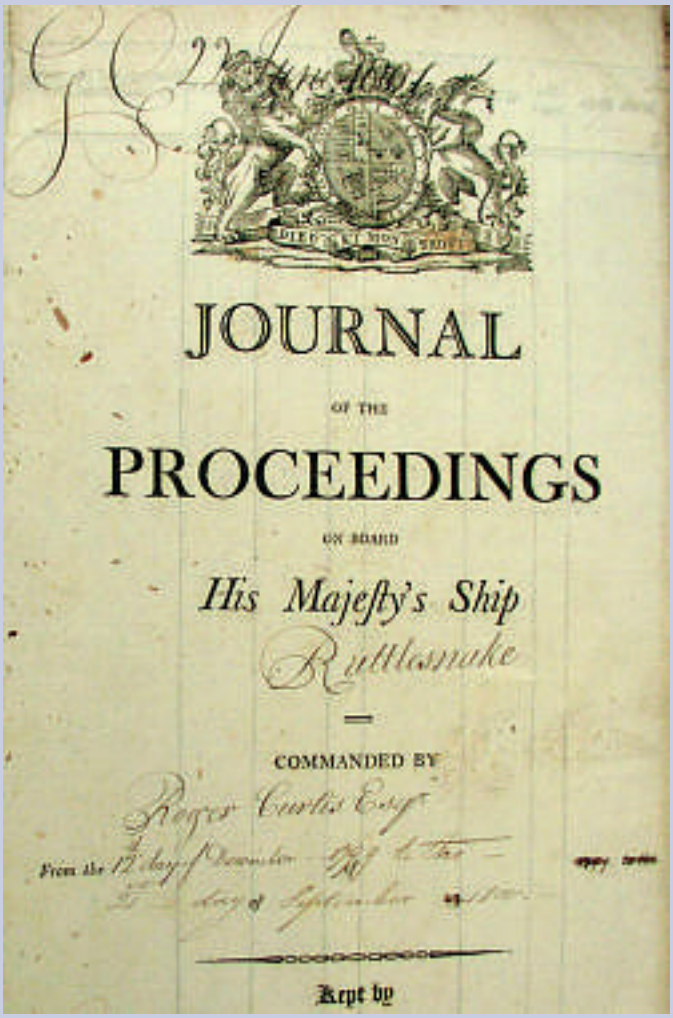
The Arctic is a region of unique sensitivity to climatic change. The possible loss of habitat, the threat of sea level rise and their respective implications for wildlife and human security are themes about which we are all aware, academic and public communities alike. However, the Arctic region is also one for which evidence of such changes is most difficult to secure.

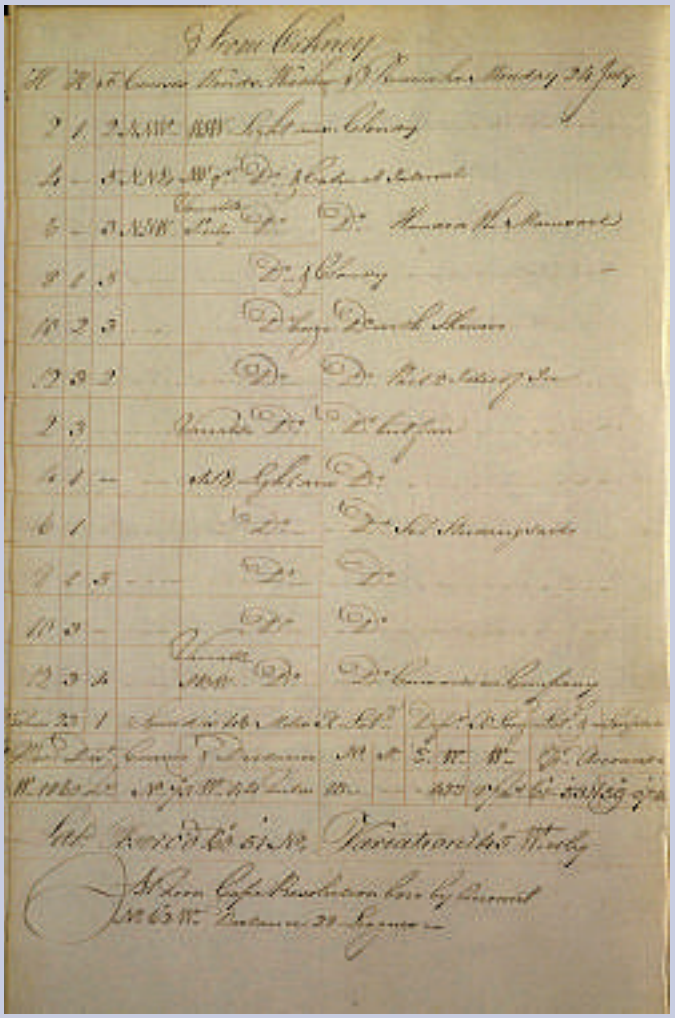
It has always been sparsely-populated and the oral traditions of the indigenous peoples have left little of the legacy of documents chronicling past climates with which we are familiar with in Europe. Only over the past three decades or so has satellite coverage provided any comprehensive picture of the extent and changes of ice cover, while instrumental observations of temperatures and related phenomena go back a little further. At a time when our need to understand past climates in order to predict better future events, this might appear to be a bleak situation for the scientist. Happily, this appearance is partly illusory and the region possesses an impressive set of documents dating back to the middle of the eighteenth century in the form of ships' logbooks all of which contain daily observations of the weather that the mariners intrepid enough to negotiate these desolate regions encountered.

Where do the logbooks come from? There are three principal sources: those of the ships of the Hudson's Bay Company, the logbooks of whaling vessels and the logbooks of Royal Navy ships. As a matter of course, and for purposes principally on navigation, all captains dutifully recorded each day: the wind direction, wind force, weather conditions and state of the sea. Whilst such observations are essentially non-instrumental in character they have been demonstrated by members of the ARCDOC team engaged in earlier logbook studies (www.ucm.es/info/cliwoc) to be of great scientific value.

In addition many of the Royal Navy logbooks also contain detailed instrumental meteorological observations of temperature and air pressure, these ships often being dispatched on voyages of scientific discovery or in search of the fabled North West Passage. Without doubt these waters were not as often-frequented as the North Atlantic routes but, nevertheless, several hundred logbooks cover the period 1750 to 1850 – a span of time chosen for the project – the former date marking the start of the observational series and the latter the beginning of more organised systems of data collection, many of which have already been gathered and collated. This period is also one of particular interest as it embraces the final decades before anthropogenic influences on climate might be expected. It also includes a period of solar quiescence known as the Dalton Minimum when there were a number of major volcanic eruptions, all of which might be expected to influence climate, and it is important to examine the degree to which the Arctic region responded to these global external forcing factors. To understand these better would be to make more confident predictions about how the region might respond to current and future changes.

Dr Dennis Wheeler
University of Sunderland





Cover image: the Swiss settler ship Lord Wellington *in danger of being crushed by ice in July 1821 whilst in the company of the Hudson's Bay Company ships* Prince of Wales *and* Eddystone*, by Peter Rindisbacher. Image reproduced by courtesy of the Public Archives of Canada ref. No. C-1915.*

Left: a typical front cover page of a Royal Navy logbook from the study period. Image reproduced by courtesy of the National Maritime Museum, Greenwich.

Right: a typical Hudson's Bay Company logbook page. This example is an entry for 24 July 1797 in logbook of the Queen Charlotte on her voyage from London to Churchill and York Fort, Hudson Bay, HBCA C.1/1012 fos. 15d-16. Image reproduced by courtesy of the Archives of Manitoba.

China and Inner Asia (1000-200 BC): interactions that changed China

Bright red carnelian beads, draped in long strings with jades in tombs of the early Chinese states, c. 850-650 BC, are vivid signs of major interactions between the Chinese elite of the day and the peoples further west in present-day Mongolia, Xinjiang province, Kazakhstan and Siberia. For the nearest comparisons are fine beads found in Iraq and other areas of the Middle East in tombs of the third and second millennium BC. And the beads are not the only exotic materials that the Chinese acquired across the huge distances of the steppes and deserts and then copied and developed in their own contexts – faience, typical of Western Asia and not China, is found with the carnelian and a new fashion for gold, previously little used, developed at the same time.

These bright, attention-attracting, materials are the brilliant signs of long-range interactions across the steppe areas to the north and west that transformed the highly populated Yellow River basin. These sparsely inhabited regions were essential bridges between the early Chinese polities and the metal-rich Altai and Ural Mountains. Unlike the first cities in Mesopotamia, where metallurgy was developed in the fourth millennium, copper and bronze arrived much later to China, and the stimuli that led to the first cast bronzes on the western periphery of the Chinese states in the late third millennium came ultimately from the Urals. Chariots and horses arrived from Siberia around 1200 BC and iron-working also came from the same region around 800 BC.

With their highly organised, relatively dense populations, early Chinese societies were able to react fast and on a large scale. Extravagant use of bronze for casting food and wine vessels, the hundreds of chariots surviving in tombs and large scale iron foundries all demonstrate the power of the Chinese to exploit innovation. The project looks at the ways in which these foreign materials and technologies reached the Yellow River across the steppes and deserts of Eurasia and tracks the web of Chinese responses. An understanding of these factors will enable a much fuller appreciation of the ways in which China's physical environment and geographical position have in the past affected and will continue today to affect, not only its technological, but also its social development.

Professor Dame Jessica Rawson
University of Oxford

Professor Jianjun Mei
University of Science and Technology, Beijing

Above: cast gold decoration for a sword hilt, 6th-5th centuries BC. The gold would have decorated a wooden hilt enclosing the tongue of a ceremonial sword in iron or bronze. Both the shape of the hilt and the choice of gold reflect the taste of peoples to the north-west of the central Chinese states.

Below: Carnelian beads from the Royal Cemetery of Ur in Iraq, mid third millennium BC. Beads similar to these found their way to China across present day Kazakhstan and Siberia and were used and copied to make elaborate burial dress for the Chinese elite from 900 BC.

Images courtesy of the Trustees of the British Museum.

Women surrealists

Surrealism is arguably the most popular and widely represented art movement of the 20th century. Despite this popularity, a number of areas within the movement remain marginalised by orthodox criticism. My research strives to reintroduce overlooked artists into the canon of surrealism, as well as scrutinise neglected work by well-known artists to expand the understanding of the movement.

My earlier work has explored surrealism in Belgium which, even though it is the second largest national concentration of the movement, has received little Anglo-American academic attention. My monograph on René Magritte (Manchester University Press, 2009), one of the best known surrealist artists, was the first critical monograph to focus on philosophical implications and other neglected aspects of his work, as well as explore his lesser known works.

In 2007, I was commissioned by Manchester Art Gallery to curate and edit the catalogue, published by Prestel, for the exhibition *Angels of Anarchy: Women Artists and Surrealism* (26.09.2009 – 10.01.2010). This was the first major exhibition in Europe on women surrealist artists; who until now have received limited art historical attention, and public knowledge of them remained restricted by their relative exclusion from exhibitions of surrealist art. My aim with this exhibition and its catalogue, including contributions by myself and leading scholars on surrealism, was to challenge this established canon, introducing new perspectives on women surrealists – three generations of artists were represented from America, Britain, Mexico, France, Switzerland, Belgium and the Czech Republic.

My current project, entitled *Lee Miller: Beyond Frontiers,* emerges out of and develops these concerns, and is contracted as a monograph with Manchester University Press. Whilst there are a number of publications and exhibitions on Lee Miller, these remain mainly biographical in focus. In addition, a number of these publications tend to reproduce, out of a vast oeuvre of over 30,000 photographs, only a limited range of artworks. My aim is to theorise well-known as well as little-known works by Miller, demonstrating that her art is an ongoing project that questions and challenges national, gender and artistic boundaries. Her work in its entirety explores mobility, transnationalism and nomadism – her fashion, war and surrealist photographs construct connected spaces where conventional boundaries are challenged.

Dr Patricia Allmer
Manchester Metropolitan University

Angels of Anarchy: Women Artists and Surrealism at Manchester Art Gallery, 26 September 2009 – 10 January 2010. Image © Manchester City Galleries, photography by Alan Seabright.

Vikings remembered: funerary drama and the origins of Norse mythology

The Viking Age (c.750-1100 AD) saw some of the most dramatic changes in the history of the northern world, including the creation of the modern Scandinavian nations. As traders, craftsworkers, warriors and colonists, Nordic peoples ranged from the Middle East and the Asian steppe to North America. In Europe they toppled kingdoms, created new states and left a legacy that included a united England and the earliest Russian towns. But what animated this extraordinary cultural expansion? How did the Norse see themselves? I will seek answers to these questions through the analysis of Viking funeral ritual.

Any culture's responses to mortality are intimately bound up with their world-views and perspective on life, and the Vikings were no exception to this. Early medieval Scandinavian attitudes to death were monumentalised in some of the most spectacular burials known to archaeology, which also preserve abundant evidence for the rituals that went into their construction. Perhaps half a million graves are known from this period, of which a few tens of thousands have been excavated. For well over a century archaeologists have recorded the massive repertoire of objects found in these contexts, producing catalogues of 'grave-goods' and using them to reconstruct the everyday life that they supposedly represent. These easy categorisations are now being increasingly questioned – not least because, many of the buried objects seem to have been manufactured for the occasion – and our focus is shifting to the funerary process itself and what it might mean. Above all, we urgently need to understand why it is that of all the excavated graves from the Viking world, no two burial tableaux are exactly the same. It is abundantly clear both from archaeological remains and contemporary textual sources that Viking funerals contained long, complex and intensely varied performances in which material manifestations of ideas were central.

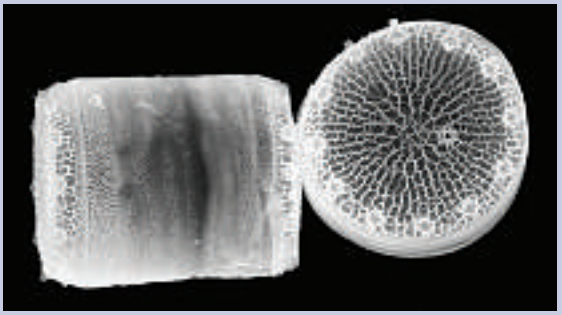
This project will review a major sample of excavated graves – from individual burials up to massive cemeteries – analysing their elaborate detail and communicating it through newly-commissioned reconstruction drawings of the kind shown here. In asking what actually went on at a Viking funeral, a central concern will be the fundamental role that narrative and storytelling played in the mindset of the time. Did these burials take the form of mortuary dramas, a kind of funeral play literally enacted at the graveside? My research will test this suggestion and consider what it might represent, comparing the archaeology with eye-witness accounts of Viking funerals left by Arab and Byzantine writers, and with the narratives illustrated on contemporary textiles and stone sculpture. If each ritual really did provide a poetic passage for the dead into a world of ancestral stories, then we must ask what happened to all those tales. Is it possible that they could be part of the beginnings of what we know today as Norse mythology?

Professor Neil Price
University of Aberdeen

Left: A complex tenth-century boat grave from Kaupang in Norway, containing the bodies of two women, a man and a baby, alongside several sacrificed animals; a second man had been buried under the keel. Reconstruction by Þórhallur Þráinsson.

Right: A high-status woman's grave from Gausel in Rogaland, Norway, dated to 850-860 AD; a severed horse's head had been placed at the foot of her coffin. Reconstruction by Þórhallur Þráinsson.

From genes to structures



Scanning electron micrograph of the silica shell from the marine diatom Thalassiosira pseudonana. *Courtesy of Nils Kröger, Georgia Tech, USA.*

Diatoms are single-celled plants of the ocean that turn water green-brownish when they form blooms. They are so productive that they contribute about 25% of the total primary production on Earth; that is as much as all tropical rainforests combined. But even more than that, they are nature's nanotechnology masters, able to produce beautifully ornamented shells made of silica. The beauty of these shells inspired artists and precise hand drawings were published by Ernst Haeckel in his book: *Artforms in Nature* at the beginning of the last century.

The architecture of these shells differs from species to species but is the consequence of an optimisation process over 300 million years of evolution. They are lightweight and porous to keep the cells afloat and to ensure exchange of nutrients and gases for growth, but they are also very stable to protect the cell. This combination of properties interested engineers because they wanted to understand how diatoms were able to lay down complex structures of silica in high order at the sub-nanometer range exceeding any current capabilities of human nanotechnology. Diatoms directly build in 3D, which is why they are so attractive for any lithographic approaches.

The application of this knowledge is evident. Silica is related to silicon which is the key element for the semiconductor industry and thus for computer chips. If engineers can genetically control the process of silicon-structure formation as diatoms already do, they would have an entirely new way of performing the nanofabrication used to make computer chips. Thus, diatom shells are of significant interest to bionanotechnologists.

Once we understand how these nanostructures are formed we will be able to create new technology. We have made the first major step in this direction by identifying the genes involved in shell formation. Approximately 75 genes out of ca. 14,000 responded (turned on or off) to the availability of silicon in a diatom for which the whole genome sequence was available. So, we now know which of the organism's 14,000 genes are most likely to be involved in making the shells.

However, the majority of these genes do not have a known function because they display no similarities to known genes from other organisms. Two of them were already selected for a more detailed functional analysis using modern molecular methods such as genome transformation in combination with phenotyping. One of them was identified as a novel gene involved in shaping the silica shell and the second one seems to be a major regulator for cell division (bloom formation) linked to the formation of the silica shell. Thus, our approach has already led to fundamental new insights into novel components of the shell and how shell formation is linked to growth (cell division).

Dr Thomas Mock
University of East Anglia

Paul A Samuelson: an intellectual biography

Paul Samuelson (1915 -2009) was the figure who, more than anyone else, towered over the discipline of economics after the Second World War, a period during which it went through a radical transformation. He was the first American to win the Nobel Memorial Prize, a decision which few economists will have questioned. Probably more than anyone else, he symbolised the trend towards the use of rigorous mathematics in economic theorising. He was a leading supporter of Keynesian economics during what came to be known as 'the age of Keynes'. He was also one of the leading pedagogues and popularisers of economics, both through his textbook, *Economics* (1948), now in its 19th edition, and through his journalism. He was instrumental in turning the economics department at MIT into what was widely considered the dominant force in academic economics, at least until the 1970s when the balance began to shift towards Chicago. He represents trends in academic economics during the postwar decades in a way that no other economist can.

Despite Samuelson's importance, he has not been the subject of much serious historical research. The aim of this project is to fill that gap by writing an intellectual biography that places the evolution of his ideas in the context of his life, his interactions with colleagues at MIT, the economics profession and the world at large. This is a daunting task not just because of the amount he wrote (around 2,700 articles, not to mention his several hundred *Newsweek* columns) but because of the sheer breadth of his work, covering many branches of economics and even some work in the natural sciences.

Clearly, any intellectual biography has to start with Samuelson's upbringing, and his training in Chicago and Harvard. Was there, for example, any connection between Samuelson's outlook on science and the presence in Harvard of sociologists Talcott Parsons and Robert Merton, or philosopher Thomas Kuhn? After his move to MIT, the main question to arise is his role in raising the profile of the economics department to the position it had achieved by the 1960s, and the nature of his interactions with his colleagues and their graduate students. The centrality of being 'scientific' to Samuelson's conception of his own work, which involved him in debates with philosophers and fellow economists over scientific method, raises further questions. Why did Samuelson specialise so much in economic theory, rather than doing more statistical work? Why did he not engage more with the types of mathematics that were increasingly being used in economic theory, and how did his work on economic theory connect with his work on fiscal policy and his popular writing on policy issues?

Though Samuelson is the project's focus, the breadth of his work may make it appropriate to adopt a broader approach. Samuelson is an important economist in his own right, but the real interest lies in using his work as a window into a very important period in the history of the economics discipline.

Professor Roger Backhouse
University of Birmingham

Shedding new light on old paintings

***Carolyn Allen,** of the Trust, reports*

Conservators welcome a powerful new imaging tool that 'sees through' layers of paint and varnish, revealing previously hidden levels of detail about paintings and other historical artefacts. The imaging tool can be used to visualise not only any preliminary sketches by the artist but the layer those sketches were made on and even what media the artist used to make the sketch.

Conservators or art historians often need to study cross-sections of paint and varnish layers to identify the pigments and media used, signs of deterioration, and to look for evidence of alterations including previous attempts to clean and conserve the paintings. Traditionally, this has involved taking samples of the painting and examining them under a microscope. To minimise any damage, these tiny samples (usually much less than one square millimetre) are only taken from the edges of paintings or from areas of the painting that are already damaged but such samples are unlikely to be representative of the painting as a whole.

In 2004, a team of researchers led by Dr Haida Liang, a physicist at Nottingham Trent University, showed that Optical Coherence Tomography (OCT) – an imaging technique originally developed for diagnostic medicine – could be used to produce 'virtual' cross-sections of paintings in a completely non-invasive way. Two years later, Dr Liang was awarded a Leverhulme Trust Research Project Grant to evaluate the possible applications of OCT for art conservation and historical studies and to refine the technique, tailoring the equipment for the needs of museum and gallery applications.

OCT is an optical interferometric technique that has revolutionised the study of superficial tissue layers in medicine, notably in ophthalmology where it is used to produce high-resolution three-dimensional images of the retina. The technique is based on echo-location, similar to ultrasound imaging but because it uses light rather than sound, it produces images with much higher resolution. An optical beam is directed at the tissue and the light reflected back from the subsurface features is collected. The time it takes for the light to be reflected back relates to the depth of the subsurface feature. Designed to safely study the internal structure of the eye, the technique is completely non-destructive and operates at a safe distance, which is also ideal for studying rare and precious artwork.

Dr Liang's project was the first large scale and systematic study of the application of OCT to art and involved close collaboration with researchers at The National Gallery, London and The British Museum. In the initial stages of the project, the researchers adapted a commercially available OCT machine to examine paintings at The National Gallery. This machine was tailored for use on biological tissues rather than the much broader range of materials encountered in historical artefacts. The results from these studies helped co-researchers at the University of Kent to design and build a bespoke portable OCT machine for use in galleries and museums.

One of the paintings examined using the commercially available machine was *The Large Dort,* an oil painting by Aelbert Cuyp, dating from around 1650, which was undergoing conservation treatment. The researchers report that the closely spaced 'virtual' cross-sections collected using OCT gave a far better indication of the variation in thickness and distribution of the remains of old varnishes across the painting surface

than was gained from real paint cross-sections taken at the same time.

OCT also proved to have an advantage over X-ray imaging, a technique routinely used to look at hidden layers of paintings. In the X-radiographs, interference from the thick lead-white-containing priming layer made it difficult to get a clear picture of the original paint layers but the OCT images could be extracted from a depth range that excluded the priming layer. The ability to select an en-face image at a specific depth makes OCT particularly suited to imaging artist's preliminary sketches because it can produce an image at the exact depth where the underdrawing is located ensuring that the paint lying on top and the priming layer below do not interfere.

In one experiment, OCT imaging of an underdrawing of lines that had been drawn with a quill pen and covered with two layers of lead paint, not only revealed the horizontal lines but also enabled the researchers to visualise the droplets of ink and the direction in which the lines were drawn.

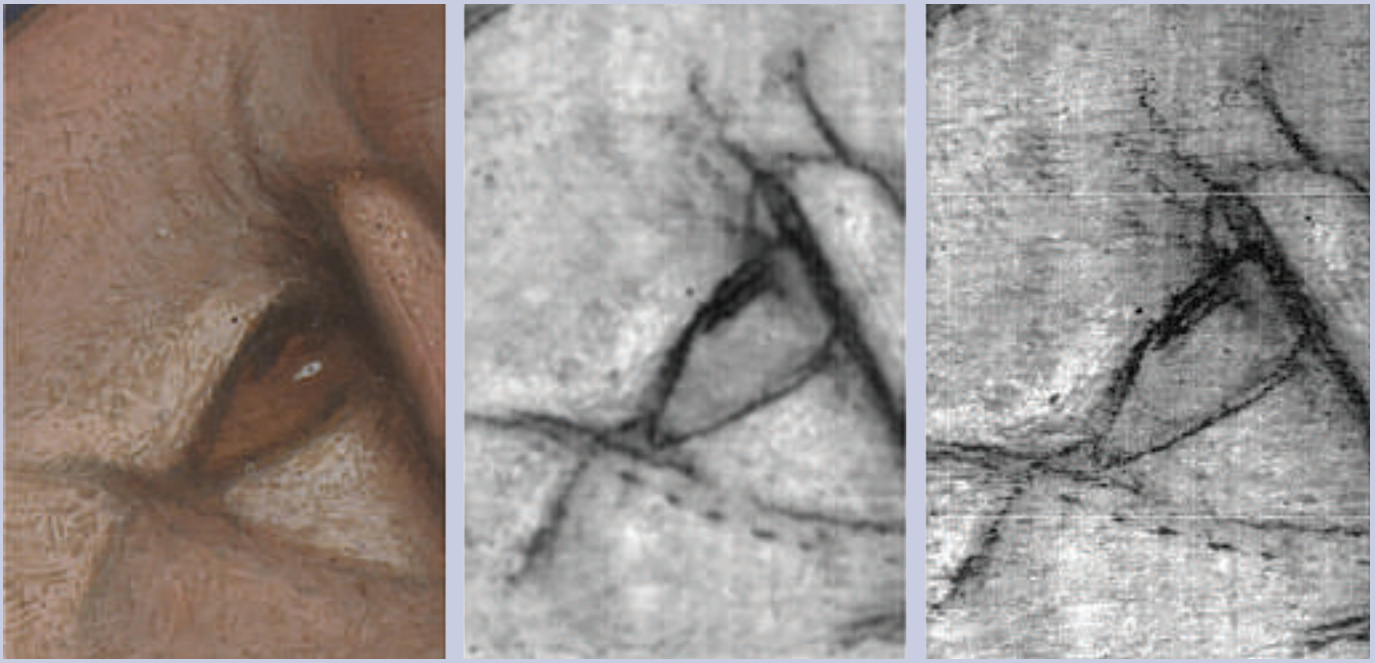
According to Dr Liang, the success of this project has helped establish Optical Coherence Tomography as a new field of imaging for art conservation and archaeology:

"We now have a much more enthusiastic response from the conservation community and even private conservators contact us wanting to have access to this type of instrument - it's not just the big museums anymore. Also, it has enabled me to get a grant of over £600,000 under the Science and Heritage programme managed by AHRC, to develop the next generation of OCT for art conservation."

Dr Liang's work was supported by a three year Research Project Grant awarded in 2005.

Left: The Large Dort, *an oil painting by Aelbert Cuyp, dating from around 1650 being examined (image © The National Gallery, London).*

Below: After Francesco Francia, The Virgin and Child with an Angel *(NG 3927) © The National Gallery, London.*



OCT gives greater resolution and dynamic range than any other imaging method currently available. This is particularly useful because the quality of the lines often gives information about the nature of the medium used for the drawing. a) After Francesco Francia, The Virgin and Child with an Angel *(NG 3927), detail of the angel's eye b) SIRIS camera Infrared image of the same region c) En-face OCT image (images © The National Gallery, London).*

Changing codes: evolution in the lab

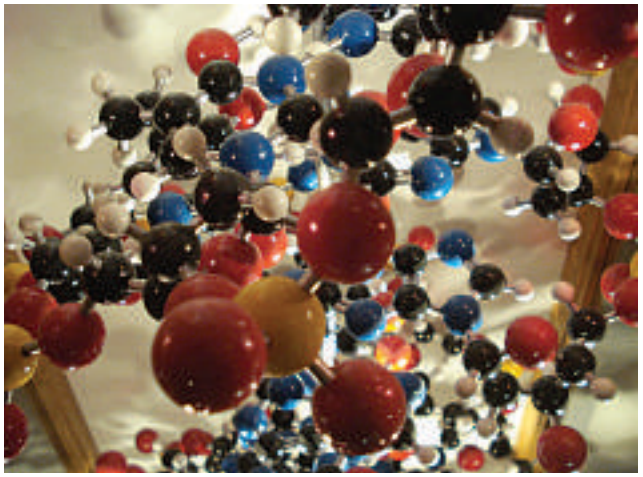
Humans use many codes, and those codes can have useful features. For example, Morse code uses its shortest signals (a dot and a dash) for the most commonly used letters (E and T), to keep messages brief. Obviously, telegraph engineers deliberately designed this advantage into Morse code. Our cells, however, use a billion-year-old code with similar advantages, whose origin is far from obvious.

Living cells store their information as DNA, but life's functions are carried out by proteins. The genetic code is the conversion table between the two. It was cracked nearly 50 years ago, and like Morse code, it shows signs of being well-adapted for its purpose: it minimises the harm caused by copying errors, and it allows additional information to be included alongside the directions for building a protein.

The genetic code is almost identical in all species, from gut bacteria to humans. Slight variations do exist, though: many single-celled parasites have unusual codes, and so do mitochondria, the microscopic energy generators within our own cells. Most of them have an altered number of 'stop' codons that tell the cell when to stop building a protein. So how do codes come to vary? Can they change readily enough to explain their beneficial features? How much does it harm a cell to change its code, and is it overwhelmingly likely to change back again?

This Research Project Grant will enable us to make subtle changes to the genetic code of a bacterium, in a way that could plausibly occur in the wild, and see the immediate and long-term consequences. Bacteria have short generation times, and large population sizes, so we can directly observe evolution happening in real time in the laboratory. Recent breakthroughs in the technology used for DNA sequencing also make it feasible, for the first time, to read and re-read whole genomes and obtain 'before and after' pictures of a bacterium's DNA, to identify the precise mutations that have contributed to evolutionary change.

As well as helping answer the questions above, about code evolution, our work could have practical applications in genetic engineering. Organisms with new genetic codes could not exchange genes with wild relatives, so it would be extremely difficult for transgenes to escape into the environment.



Our DNA contains information written in an ancient code whose origin is yet to be understood (image © Christian Guthier).

Dr Louise Johnson
University of Reading

(Co-applicants: **Dr Robert Jackson, *University of Reading*** and **Dr Michael Brockhurst, *University of Liverpool***)

Sacred kingship and religious change in the early modern world

Why is it that some societies became Christian or Muslim in the early modern period (c.1450-c. 1850), while others resisted the advances of monotheism? One very important means by which the world religions have spread is through a 'top-down' process: first convert the monarch and then all his or her subjects will eventually follow suit. But this seems to have only worked in some parts of the world.

Consider, for example, two rulers, one in Africa, one in Asia. Both are about to undergo the ceremony of baptism following first contact with the Portuguese – but they insist that the rite be conducted in secret. The African ruler is a regional governor (the Mani Soyo) of the King of Kongo, who has received an embassy led by the sea captain Diogo Cão in 1491. The Mani Soyo is anxious that his subordinates should not share in the ritual and even refuses to let his people touch the bones that he and the Christians have left from their celebratory feast. It seems that he does not want everyone to benefit from the enhanced status and power that these new rituals could bestow. Yet he is forced to give in and make baptism widely available. That year his liege, the King Nzinga Nkuwu, also converts, and the seeds of a Christian dynasty are planted in the Kongo.

In the highlands of Sri Lanka some fifty years later, the King of Kandy is equally intent on keeping his baptismal rites hidden from public view. But his reasons are strikingly different. He does this lest his people should kill him. When news of the baptism did leak out rioting followed, and the king had to spread the story that it had all been a ploy to deceive the Portuguese. No Christian dynasty survived in Sri Lanka.

Why is it then that the rulers of some societies could convert to monotheism and retain their legitimacy, while elsewhere rulers knew that conversion would destroy it?

Ultimately, the answer may help us to explain the religious map of the world today. But I also intend to use these moments of ruler conversion dilemmas to gain a deeper understanding of the nature of the relationship between religion and politics across the early modern world. My hunch is that the term 'religion' masks a distinction between 'transcendentalist' salvation-oriented creeds on the one hand and ritual practices concerned with this-worldly flourishing on the other – and that these interact with politics in rather different ways.

Dr Alan Strathern
University of Cambridge

Manikongo João I of Kongo, alias Nzinga a Nkuwu or Nkuwu Nzinga, Pierre Duflos *(1742-1816).*

Of whales and men

Humpback whale breaching, Cape Cod, Summer 2008 (© Philip Hoare).

In 2008, I published my sixth work of non-fiction, *Leviathan or, The Whale,* a personal attempt to explain the fascination which I have long felt for whales. It seems to me that we are at a crucial point in history regarding our relationship with these animals; indeed, anthrozoology is itself a new discipline. Only a generation separates us from the time when whales were regarded as an industrial resource to be exploited (literally so: until the widespread use of mineral oil in the second half of the 19th century, the industrial revolution was lit and lubricated by whale oil).

Now we see whales as emblems of natural wonder, and environmental threat – precisely because our behaviour so nearly brought them to the brink of extinction. As a writer, I am fascinated with the way that the image and the actuality of the whale interact, and contradict themselves. From the book of Genesis to Moby-Dick, the whale is a shape-shifter in our culture, changing to suit our needs – yet forever elusive. These are the largest, loudest, longest-lived animals on earth – yet who amongst us has ever seen a whale? Whale science is only thirty years old; its discoveries are expanding, even as new writers, poets, artists and film-makers are being inspired by whales, and their place in our culture.

My proposed residency will vitally inform these ideas by enabling me to create a dialogue between the scientists of the Marine Institute and the arts discipline represented by myself, by the Department of English at the University of Plymouth, and Peninsula Arts. During my time at Plymouth I hope to draw on creative/knowledge relationships established throughout the residency to enrich my experiences in the field and allow me to set them in scientific, artistic, historical, and literary context. A particular and important emphasis will be on environmental change, as charted in the reality and symbol of the whale, but also of the greater oceanographic and anthropological picture. In the process, key connections will be made, linking the work of the University of Plymouth, the Marine Institute and Peninsula Arts with similar institutions in America, Europe, Australasia and the Pacific Rim.

A key part of my practice as a writer is communication and education. I have lectured on the subject of the whale throughout the world, as well as teaching writing courses in schools, universities and prisons. My work at Plymouth will thus extend into a greater public and international arena, maintaining a fertile sense of interdisciplinary dialogue on the subject. I regard this residency as an essential starting point and anchor for this project.

Philip Hoare
Marine Institute, University of Plymouth

Philip Hoare's book, *Leviathan or, The Whale,* winner of the 2009 BBC Samuel Johnson prize for non-fiction, is published by Fourth Estate.

Cover: Sperm whale, Kaikoura, New Zealand, March 2010 (© Philip Hoare).

Planetary atmospheres

The overall aim of my research is to draw upon many diverse areas of planetary, Earth, and atmospheric science in order to increase our understanding of fundamental processes. The planets and moons of our Solar System provide us with a unique opportunity to test our understanding of these processes, some of which we think we understand for the Earth, and see how they operate under different physical and chemical conditions.

There are four terrestrial bodies in our Solar System with significant atmospheres: Earth, Mars, Titan, and Venus. My research will focus on Saturn's moon Titan, which has a thick nitrogen and methane atmosphere containing a vast array of complex hydrocarbon and nitrogen bearing species produced by photochemistry in the upper atmosphere.

Titan is arguably the most relevant Solar System body for comparison with the Earth and has many analogous processes – such as primitive organic chemistry, clouds, rain, and seasonal cycles. At present we understand most aspects of the Earth's atmosphere in much more detail than we do for Titan. Thus, comparing the Earth and Titan helps build up an initial picture of how Titan's atmosphere works. However, because of Titan's very long year (29.5 Earth years) and massively extended atmosphere, there are certain phenomena that are much easier to observe on Titan than on Earth. Examples include a tilted atmospheric symmetry axis and a strong equatorial mixing barrier. Both these processes have been tentatively observed on Earth but are very obvious and better characterised on Titan.

We are therefore very close to being able to use comparative planetology as a tool for increasing our comprehension of the Earth system. Our initial goal is to observe seasonal changes as Titan moves from northern winter to northern spring. Titan currently has an intense winter polar vortex – just like over Antarctica on Earth – so observing the mechanism by which Titan's spring vortex breaks up will provide insights into polar processes in general. Titan's atmospheric evolution will be observed in detail using NASA/ESA's Cassini spacecraft, which is currently orbiting Saturn. Seasonal changes in the distribution of trace gases will be used to probe atmospheric circulation and chemistry during this exciting period.

Another aspect of my research is planetary interiors and surfaces. High quality seismic and magnetic data mean that a lot is already known about the Earth's interior and geology. Although there is lots still to understand from an Earth science perspective, I would like to take an alternative approach by comparing the Earth's interior to other planets in the Solar System. There are currently very few constraints on interiors of other planets and a seismological investigation of Mars, for example, would decrease the uncertainties by many orders of magnitude. There is now a significant body of evidence indicating that Mars was a lot warmer and wetter in the early Solar System, which implies a link between its early atmosphere and interior. By placing the Earth's interior in a planetary context we will be in a much better position to consider how the terrestrial planets formed and differentiated.

The small icy moon Dione passes in front of a haze shrouded Titan [NASA/JPL].

Dr Nicholas Teanby
University of Bristol

Grants awarded by the Board at their November 2010 meeting

The numbers in parentheses are the awards duration in months.

Research Project Grants

Applied sciences (including architecture)

Dr Alexandra Porter *Imperial College London*	The bioreactive and toxicological potential of carbon nanotubes in the lung	£243,285	(36)
Dr Dennis Wheeler *University of Sunderland*	Arctic climate change 1750 to 1850: new insights from old documents	£249,864	(36)
Dr Catherine Higgitt *British Museum*	Andean textiles: organic colourants, biological sources and dyeing technologies	£151,400	(36)
Dr Konstantin Vasilevskiy *Newcastle University*	GRApheNe Transistor grown by local solid phase epitaxy	£248,103	(36)
Professor Nick Jelley *University of Oxford*	A low-cost solar concentrator using simple surfaces	£224,754	(36)

Basic sciences

Professor Anthony Davis *University of Bristol*	Chiral encoding in the origin of life?	£106,009	(24)
Professor Juan Garrahan *University of Nottingham*	Non-equilibrium dynamics of open quantum systems	£147,212	(36)
Dr Sharon Ashbrook *University of St Andrews*	Ionothermal 17O enrichment and solid-state NMR of microporous solids	£162,944	(36)
Professor Zhaohui Luo *Royal Holloway, University of London*	Lexical semantics in type theory with coercive subtyping	£147,661	(36)
Dr Mark Brown *Royal Holloway, University of London*	Are bumblebees the Extended Phenotype of nematodes? A transcriptomics approach	£110,528	(24)
Professor Stephen Mann *University of Bristol*	The quest for molten proteins	£157,485	(36)
Professor David Wild *University of Warwick*	Analysing protein energetics with statistical machine learning	£197,690	(36)
Dr Jonathan Lee *University of Birmingham*	Prediction error and memory reconsolidation	£208,486	(36)
Professor Neil Cameron *Durham University*	A synthetic cell that displays receptor mediated endocytosis	£230,121	(36)
Professor William Barnes *University of Exeter*	Plasmonics and gain: underpinning science	£143,405	(36)
Dr Susan Perkin *University College London*	The electrical double layer in pure ionic liquid next to an electrode surface	£109,332	(24)
Professor Patrick Haggard *University College London*	Neuropsychology of choreographic patterns in aesthetic perception of dance	£114,771	(30)
Professor Richard Compton *University of Oxford*	Characterisation of nanoparticles for environmental monitoring	£215,735	(36)
Professor Simon Liversedge *University of Southampton*	Phonological processing during silent reading in children with PCHI	£245,959	(36)
Dr Alban Potherat *Coventry University*	A new approach to the numerical simulations of magnetohydrodynamic duct flows	£133,702	(36)
Dr John Moses *University of Nottingham*	Biomimetic asymmetric synthesis in biological membranes	£232,580	(36)
Professor Neil Roberts *University of Plymouth*	Deforesting Europe: a pollen-based reconstruction of Holocene land cover change	£146,741	(36)
Professor George Wolff *University of Liverpool*	A molecular 135,000-year record of environmental change from Lake Ohrid	£170,947	(36)
Professor Philip Moriarty *University of Nottingham*	Mapping molecular force fields and energy landscapes with picometre resolution	£145,790	(36)
Professor John Maurice Campbell Plane *University of Leeds*	Lab-on-a-chip synthesis of cosmic dust analogues	£176,774	(36)
Dr Enzo Pascale *Cardiff University*	A study of Galactic polarised dust with BLASTpol	£184,329	(27)
Professor Gurdyal Besra *University of Birmingham*	Lipid, sugar and protein biomarkers for ancient tuberculosis and leprosy	£172,984	(36)
Dr Thomas Mock *University of East Anglia*	From genes to structures: how diatoms form their nano-structured silica shells	£161,350	(36)

Professor Rod Blackshaw *University of Plymouth*	An integrated theoretical and experimental approach to understanding insect trap	£249,443	(36)
Dr Gregory Edgecombe *Natural History Museum*	Extrapolating the central nervous system of Cambrian ecdysozoans	£144,707	(36)
Dr Sinead Drea *University of Leicester*	The Evolution of Fruit Form	£148,860	(36)
Dr Louise Johnson *University of Reading*	Experimental evolution of novel genetic codes and their genomic consequence	£151,014	(36)
Dr Peter Doerner *University of Edinburgh*	Synthetic polymer arrays to isolate, enrich and grow specific plant cell types	£134,476	(24)
Dr David Angeli *Imperial College London*	Structural conditions for oscillation in chemical reaction networks	£99,359	(24)
Dr James Spencer *University of Bristol*	Cfr, a radical SAM enzyme catalysing rRNA methylation at unreactive centres	£47,911	(12)
Dr Martin Lages *University of Glasgow*	Perceived 3D trajectory of line motion	£78,097	(24)
Dr Carol Wagstaff *University of Reading*	Identifying targets for improving the nutritional content of cruciferous crops	£90,980	(24)
Dr Paul Elliott *University of Huddersfield*	Development of novel luminescent ruthenium, iridium & platinum cyclometalates	£93,034	(24)
Professor Andrei Malkov *Loughborough University*	Kinetic resolution of secondary allylsilanes in the asymmetric allylation	£99,442	(24)

Humanities

Dr Neil McLynn *University of Oxford*	Late antique Egypt and the Holy Land: archaeology, history and religious change	£334,741	(48)
Professor Dame Jessica Rawson *University of Oxford*	China and Inner Asia (c. 1000-200BC): interactions that changed China	£499,301	(60)
Dr William Wootton *King's College London*	The art of making in antiquity: stone carving and carvers in the Roman world	£209,834	(24)
Professor Philip Schwyzer *University of Exeter*	Speaking with the dead: histories of memory in English sacred space	£208,737	(36)
Dr Mary Lewis *University of Reading*	Adolescence, migration and health in medieval England: the osteological evidence	£230,410	(36)
Dr Catherine Leglu *University of Reading*	Genealogies, histories and translation: MS British Library Egerton 1500	£174,072	(24)
Dr Tarnya Cooper *National Portrait Gallery*	Materials & techniques/ functions & meanings: Tudor and Jacobean painting	£248,114	(60)
Professor Anne Hudson *University of Oxford*	Mass production, clandestine circulation? Wycliffite Bibles in Oxford libraries	£181,729	(36)
Professor Dorothy Severin *University of Liverpool*	The culture of Spanish verse in the late Middle Ages	£155,731	(30)
Dr Fiona Macintosh *University of Oxford*	Performing epic from antiquity to the present	£153,789	(36)
Dr Guido Bacciagaluppi *University of Aberdeen*	'The Einstein Paradox': the debate on nonlocality and incompleteness in 1935	£147,909	(36)
Dr Luke Lavan *University of Kent*	Visualising the Late Antique City: everyday life AD 300-650	£182,598	(36)
Professor Robyn Carston *University College London*	Understanding metaphor: ad hoc concepts and imagined worlds	£237,745	(36)
Professor William Sheils *University of York*	Clerical taxation in the northern ecclesiastical province of England 1173-1664	£101,669	(24)
Professor Patrick Sims-Williams *Aberystwyth University*	Grammatical conversation and innovation in thirteenth-century Welsh texts	£78,413	(20)
Professor Mark Pollard *University of Oxford*	Chemical structure and human behaviour: a new model for prehistoric metallurgy	£96,591	(24)

Economics, business studies, industrial relations

Professor Paul Anand *Open University*	The capabilities approach to economic progress and human welfare	£197,828	(34)
Dr Anders Poulsen *University of East Anglia*	Understanding unstructured bargaining situations: experimental evidence	£65,878	(18)

Social studies (incl. anthropology, geography, social psychology)

Professor Glyn Humphreys *University of Birmingham*	Empirical and philosophical analyses of motion-induced-blindness (MIB)	£118,132	(24)

Dr Ayse Uskul *University of Essex*	Promotion of healthy eating using visual perspectives in mental imagery	£79,985	(12)
Dr Patrick Leman *Royal Holloway, University of London*	Ethnicity, learning and children's interactions at school	£84,686	(24)

Fine and performing arts

Ms Trish Belford *University of Ulster*	Experimental archaeology meets textile design: the rediscovery of shadow tissues	£111,648	(24)

International Networks

Basic sciences

Professor Louise Harra *University College London*	Probing the Sun: inside and out	£124,677	(36)
Professor Kevin Flynn *University of Swansea*	Placing marine mixotrophs in context modelling mixotrophy in a changing world	£98,160	(30)

Social studies (incl. anthropology, geography, social psychology)

Professor David Marshall *University of Edinburgh*	Discursive families: a comparison of magazine advertising in two countries	£41,508	(12)

Economics, business studies, industrial relations

Dr Kevin Gray *University of Sussex*	Emerging powers of the global south	£79,947	(36)

Humanities

Dr Jo Gill *University of Exeter*	Suburban cultures network	£68,836	(36)

Law, politics, international relations

Douglas Guilfoyle *University College London*	The modern laws of high seas piracy project	£16,072	(12)

Art Bursaries / Arts Initiatives

Ms Hilary Boulding *Royal Welsh College of Music and Drama*	Training bursaries for MA opera performance	£105,000	(36)
Professor Mark Racz *Royal Academy of Music*	Leverhulme Group Fellowship for chamber music	£112,640	(36)
Ms Deborah Callan *Shakespeare's Globe Trust*	Sam Wanamaker Festival	£56,112	(36)
Ms Isobel Timms *London Philharmonic Orchestra Limited*	Young composers project	£75,059	(36)
Ms Nina Camilleri *National Youth Choirs of Great Britain*	Provision of bursaries to support members	£69,900	(36)
Ms Suzanne Bell *Liverpool and Merseyside Theatres Trust Ltd*	Liverpool Everyman and Playhouse playwright support	£90,000	(36)

Artists in Residence

Anna Dumitriu *Nuffield Department of Clinical Medicine John Radcliffe Hospital, University of Oxford*	Visual arts	£12,500	(12)
Catherine Burge *Royal Armouries Museum, Leeds*	Sculpture	£11,000	(12)
Carolyn Deby *Urban Laboratory, University College London*	Choreography	£12,500	(10)
Timberlake Wertenbaker *Freud Museum, London*	Theatre	£12,325	(10)
Alec Finlay *School of Built Environment/Department of Arts, Northumbria University*	Visual arts and poetry	£12,500	(10)
Duncan MacKay *Centre for Astrophysics & Planetary Science, University of Kent*	Poetry and visual arts	£12,000	(10)
Eleri Pound *School of Mathematics, University of Leeds*	Music	£12,000	(10)

Geraldine Cox *Institute for Mathematical Sciences, Imperial College London*	Visual arts	£15,000	(12)
Philip Hoare *Marine Institute, University of Plymouth*	Creative writing	£12,500	(4)

Major Research Fellowships

Professor Roger Backhouse *University of Birmingham*	Paul A Samuelson: an intellectual biography	£155,831	(36)
Professor Paul Binski *University of Cambridge*	The heroic age of Gothic: invention and its contexts in English medieval art, 1200-1400	£146,203	(36)
Professor Diane Blakemore *University of Salford*	Expressives, communication and the representation of consciousness	£101,348	(24)
Professor Rachel Bowlby *University College London*	A child of one's own: on parenthood	£92,713	(24)
Dr Michael Broers *University of Oxford*	Napoleonic civilization: a regime and its agendas	£96,630	(24)
Professor Stella Bruzzi *University of Warwick*	Approximation: documentary, history and staging reality	£101,450	(24)
Dr Serafina Cuomo *Birkbeck, University of London*	Ancient numeracy	£136,215	(36)
Professor Trevor Dadson *Queen Mary, University of London*	The life of Diego de Silva y Mendoza, Count of Salinas and Marquis of Alenquer	£103,133	(24)
Dr Ingrid De Smet *University of Warwick*	Secrets and their keepers in Renaissance France, c.1560-1620	£155,201	(36)
Dr Marina Frolova-Walker *University of Cambridge*	The Stalin Prize: fostering socialist realism in music	£98,760	(24)
Professor Steve Hindle *University of Warwick*	The social topography of a rural community: Chilvers Coton, c.1650-1750	£102,170	(24)
Professor Anders Holmberg *Newcastle University*	The syntax of Yes and No	£88,758	(24)
Professor Stephen Houlgate *University of Warwick*	Essence and concept in Hegel's Science of Logic	£150,398	(36)
Professor Tim Ingold *University of Aberdeen*	Bringing things to life: creative entanglements in a world of materials	£102,257	(24)
Professor Grant Jordan *University of Aberdeen*	Reassessing Lijphart: competing images of democratic institutions	£102,955	(24)
Dr Elizabeth Lambourn *De Montfort University*	West Asia in the Indian Ocean 500-1500 CE	£85,859	(24)
Dr Mary Laven *University of Cambridge*	Objects of devotion: the material culture of Italian Renaissance piety	£103,560	(24)
Professor David Livingstone *Queen's University, Belfast*	The empire of climate	£152,182	(36)
Professor Richard McCabe *University of Oxford*	'An ungainefull Arte': poetry, patronage and print in early modern England	£151,631	(36)
Professor Duncan McCargo *University of Leeds*	Judicialisation and politics in Thailand: the new Extraconstitutionalism?	£150,589	(36)
Professor Christopher McCrudden *University of Oxford*	An integrated theory of comparative human rights law	£155,349	(36)
Professor Neil Price *University of Aberdeen*	Vikings remembered: funerary drama and the origins of Norse mythology	£156,222	(36)
Professor Kimberley Reynolds *Newcastle University*	Modernism, the Left, and progressive writing for children, 1900-1945	£83,616	(24)
Professor Richard Schoch *Queen Mary, University of London*	The history of British Theatre History from the Restoration to Modernism	£158,072	(36)
Professor Jenny Steele *University of York*	Liability, insurance and society: the politics and economy of private law	£141,638	(36)
Professor Richard Vinen *King's College London*	National Service, 1945-1963	£86,043	(24)
Professor George Walker *Queen Mary, University of London*	Financial law – financial regulation, crisis and stability	£104,133	(24)
Professor John Walter *University of Essex*	Covenanting citizens? The Protestation Oath and the making of a popular Parliamentarian culture in the English Revolution	£100,822	(24)
Dr John Watts *University of Oxford*	Renaissance England, 1461-1547	£141,849	(36)
Professor Charles Withers *University of Edinburgh*	The geography and history of the Prime Meridian	£107,863	(24)

Philip Leverhulme Prizes

Earth, Ocean and Atmospheric Sciences

Dr Arwen Deuss *University of Cambridge*	Geophysics and seismology	£70,000 (24)
Dr Daniel Lunt *University of Bristol*	Palaeoclimate modelling	£70,000 (24)
Dr Tamsin Mather *University of Oxford*	Volcanology	£70,000 (24)
Dr Alberto Naveira Garabato *University of Southampton*	Physical oceanography	£70,000 (24)
Dr Nicholas Teanby *University of Bristol*	Planetary atmospheres	£70,000 (24)

History of Art

Dr Patricia Allmer *Manchester Metropolitan University*	Surrealism	£70,000 (36)
Dr Celeste-Marie Bernier *University of Nottingham*	African American art	£70,000 (24)
Dr Grace Brockington *University of Bristol*	Art in Britain	£70,000 (24)
Dr Alain George *University of Edinburgh*	Islamic art	£70,000 (24)
Dr Tara Hamling *University of Birmingham*	British art	£70,000 (24)

Law

Dr Sylvie Delacroix *University College London*	Jurisprudence	£70,000 (24)
Mr Ben McFarlane *University of Oxford*	Property law and trusts	£70,000 (24)
Professor Vanessa Munro *University of Nottingham*	Socio-legal studies / feminist legal theory	£70,000 (36)
Professor Mathias Siems *University of East Anglia*	Comparative law	£70,000 (24)
Dr Ralph Wilde *University College London*	International law	£70,000 (24)

Mathematics and Statistics

Dr Caucher Birkar *University of Cambridge*	Pure mathematics (algebraic geometry)	£70,000 (24)
Dr Timothy Browning *University of Bristol*	Number theory	£70,000 (24)
Dr Tom Coates *Imperial College London*	Pure mathematics	£70,000 (36)
Dr Radek Erban *University of Oxford*	Applied mathematics	£70,000 (36)
Dr Nicolai Meinshausen *University of Oxford*	Statistics	£70,000 (36)

Medieval, Early Modern and Modern History

Dr Angus Gowland *University College London*	Intellectual and cultural history of early modern Europe	£70,000 (24)
Dr Julia Lovell *Birkbeck, University of London*	Modern Chinese history	£70,000 (24)
Dr Giorgio Riello *University of Warwick*	Global history	£70,000 (24)
Dr Alice Rio *King's College London*	Medieval history	£70,000 (24)
Dr Alan Strathern *University of Cambridge*	World history	£70,000 (24)